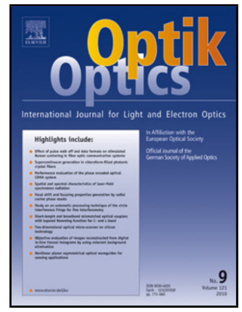

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Design and modeling of an optical band gap matched temperature controlled indoor concentrated light transmission system for photovoltaic energy production

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1. Abstract

This paper reports, the design, and modeling of a band gap matched, actively temperature controlled indoor photovoltaic optical system for solar spectral irradiance ranging from 350nm to 870nm (visible and part of near infrared) by employing Cadmium Sulfide/ Cadmium Telluride (CdS/CdTe) thin layer solar cell. In this case, an existing indoor daylighting system having 45.91% efficiency is remodeled to be a more an efficient light concentrating source with an improved light transmission efficiency of 51.65% for the proposed system. Under band gap matched conditions of the light spectrum and active temperature controlled environment, for a CdS/CdTe solar cell with 0.06%/mV as temperature coefficient, a 0.5% increase in cell efficiency and negation of ~1.7% efficiency decay due to 12^{o}C temperature rise is theoretically predicted. A commercially available CdS/CdTe solar cell with 860.73W/m^2 as integrated input solar irradiance and of 0.085m^2 area, an outdoor efficiency of 14.52% produces 10.62 W. The modeled system theoretically predicts ~1.16 times more energy from the same system in addition to an extended life due to indoor conditions. Modeling and simulation of the proposed system are performed by using *MATLAB V*-9.2 and *OptiSystem V*-14.0 software showing a good agreement with theoretically predicted results.

Keywords: Day-lighting; Low concentrated solar photovoltaic; Indoor photovoltaic system; Active temperature controller.

1. Introduction

Indoor solar lighting systems (ILS) are used to illuminate the building interiors via utilizing the concept of concentrating optics [1,2] but have not been proved an efficient choice for the energy generation from existing Si-based photovoltaic technology or tandem solar cells. A day-